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ABSTRACT

Some research on the stimulant effect of caffeine suggests that the amount of behavioral enhancement produced by caffeine may depend on subjects' prior experience with the task and the drug. A study was undertaken to test whether prior experience with a task while under the influence of caffeine would facilitate performance of that task. Male (N=20) and female (N=20) college students were assigned to high or low caffeine user groups based on their self-reported caffeine consumption. Subjects received either 200 milligrams of caffeine or a placebo, orally, before completing tasks which they were likely to have performed previously while using caffeine (writing rate and reading comprehension) and which they were unlikely to have performed previously while using caffeine (tapping rate, reaction time, and serial learning). Subjects also completed the Extroversion/Introversion scale and guessed whether or not they had been given caffeine. Data analyses revealed that caffeine consumption produced no significant effects on reading comprehension, writing rate, tapping rate, reaction time, or serial recall. The drug guess test showed that subjects were not able to detect which drug they had received. A significant positive correlation was found between extroversion/introversion scores and caffeine consumption, suggesting a strong relationship between extroversion and caffeine use. (NRB)

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CAFFEINE USE AND EXTROVERSION [1]

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CAFFEINE USE AND EXTROVERSION

Abstract

Twenty male and twenty female college students were assigned to high or low caffeine user groups based on their self-reported caffeine consumption. Subjects received either 200 mg of caffeine or placebo, orally. Tests of extroversion/introversion, tapping rate, serial learning, reaction time, writing rate, reading comprehension and drug guessing indicated no significant main effect of drug administration. A significant positive correlation ($r=.411$; $p < .01$) was found between extroversion/introversion scores and caffeine consumption, suggesting a strong relationship between extroversion and caffeine use.

CAFFEINE USE AND EXTROVERSION

Weiss and Laties (1962) observed that the bulk of caffeine research is quite old, some of the most comprehensive and careful studies being done by Hollingworth (1912). Estler's (1982) review of the literature indicates that caffeine tends to increase vigilance and decrease fatigue in test situations. Rall (1980) suggests that the effects of caffeine are situation-specific; that is, the effect depends largely on the conditions at the time of administration and dosage.

Weiss and Laties (1962) also suggest that personality plays a role in caffeine's effects. With caffeine, an introvert may be susceptible and an extrovert resistant. Eysenck and Folkard (1980) found that personality interacted with time of drug administration and level of use. Revelle, Humphreys, Simon, and Gilliland (1980) found that introverts are more sensitive to caffeine than extroverts.

Meliska, Landrum, and Loke (1985) reported that in rats, caffeine's stimulant effect was greater after subjects have had experience with the task (wheelrunning) while under the influence of the drug. Their findings suggest that the amount of behavioral enhancement produced by caffeine may depend on subjects' prior experience with the task and the drug.

The hypothesis of the present research was that prior experience with a task while under the influence of caffeine facilitates performance on that task. To test this hypothesis with college students, we selected tasks which they were likely to

have performed previously in conjunction with caffeine: writing rate and reading comprehension. Three other dependent measures -- tapping rate, reaction time, and serial learning -- were selected because it was likely that subjects would not have performed these tasks while under the influence of caffeine. Generally, caffeine increases performance on these kind of tasks (Revelle, et. al., 1980; Broverman, Klaiber, Kobayashi, & Vogel, 1968).

The last two dependent measures were an extroversion/ introversion scale (Hollingworth, 1931) and drug guessing. Previous research (Revelle, et. al., 1980; Eysenck & Folkard, 1980) has indicated that caffeine can be a contributing factor in the personality of an extrovert or an introvert. Drug guess was included to determine whether the subjects could accurately detect whether they received caffeine or placebo. Previous research (Loke & Meliska, 1984) suggests that they can.

METHOD

Subjects. The subjects were 20 male and 20 female Monmouth College students who volunteered to participate. The male and female groups were balanced to contain 10 frequent caffeine users and 10 infrequent caffeine users.

Apparatus. The writing task used paragraphs of typewritten text from an unpublished manuscript by the author. The reading comprehension task was selected from the verbal practice items from the Graduate Record Examination (Revelle, et.al., 1980; Eysenck & Folkard, 1980). Tapping, reaction time, and serial learning were measured with computer programs. Tapping rate was defined as the number of presses made on the computer keyboard in 5 minutes. Reaction time was defined as the average time (over

15 trials) taken to respond to a presented stimulus. (A "5-4-3-2-1 countdown" was presented on the screen, and as soon as the "0" was presented the subject was required to press the space bar.) The serial learning task was defined as the number of words accurately recalled from a 12 word CVC list after two presentations of the list. The CVC's were selected at random from a standardized list (Glaze, 1928). The extroversion/introversion scale was administered in the same fashion as Hollingworth (1931). The drug guess question was included at the end of the experiment.

Non-caffeinated, "diet" Coca-Cola was administered in 8 oz. portions. The caffeine group received 200 mg caffeine (hydrous alkaloid/MERCK) dissolved in the drink, similar to previous research (Revelle, et. al., 1980). The placebo group received the beverage without caffeine. Drinks were administered in a double-blind fashion.

Procedure. One week before the experiment, 96 students from the subject population were surveyed about their typical caffeine consumption. The high- and low-user caffeine groups were determined by ranking the 96 students and selecting the 10 male (268.8 $\pm$ 53.4 gm/wk) and 10 female (243.6 $\pm$ 45.7 gm/wk) lowest-caffeine users and the 10 male (1312.8 $\pm$ 268.3 gm/wk) and 10 female (1728.1 $\pm$ 170.9 gm/wk) highest-caffeine users. These subjects were then randomly assigned to either caffeine or placebo groups.

The subjects were asked to not consume any caffeinated beverages starting 3 hours before testing. Upon arrival at the

laboratory, subjects were asked to read and sign a statement of full disclosure describing the experiment, including the drug involved and possible side effects. Up to fourteen subjects were tested at a time. Half were assigned, at random, to the computer-testing (tapping, reaction time, and serial learning) first while the other half received the non-computer (writing rate and reading comprehension) testing first. Each subject was then given and instructed to drink all of the 8 oz. carbonated beverage.

One hour passed between finishing the drink and the start of testing, during which the subjects watched a videotape. Following the videotape the subjects completed the Extroversion/ Introversion scale.

The non-computer group was seated together in a room, where they completed the reading comprehension task in 15 minutes and the writing task in the remaining 15 minutes. After completing their first test, the computer and non-computer groups switched; after the second test they reassembled and the drug guess was completed.

RESULTS

Reading comprehension, writing rate, serial learning recall, tapping, and reaction time were each analyzed with separate, 3 factor (USER X SEX X DRUG) between-groups ANOVAs. The analyses indicated that males had higher mean tapping rates than females ($F = 12.75$; $p < .001$), regardless of caffeine administration or habitual level of caffeine use.

Trends approaching significance were observed in the sex X drug interactions in reading comprehension ($F = 4.01$; $p < .10$) and

serial learning ($F = 3.18$; $p<.10$). Two non-significant trends in user effects (caffeine experience) were also noted for serial learning ($F = 3.18$; $p<.10$) and tapping rate ($F = 2.88$; $p<.10$).

A Pearson correlation was calculated on reported caffeine intake and extroversion/introversion scores. A significant positive correlation ($r = +.411$; $p<.01$), indicated that caffeine consumption and scores on the extroversion scale covaried.

The drug guess test ($X^2 = .302$; $p>.50$) showed subjects were not able to detect which drug they had received.

All other effects were non-significant. In particular, caffeine administration produced no significant effects on reading comprehension, writing rate, tapping rate, reaction time, and serial recall.

DISCUSSION

A significant effect of drug administration was notably absent. This was also reported by Revelle, Amaral, and Turriff (1976). They found no performance superiority for extroverts or introverts, and suggested that caffeine neither raises nor lowers average performance, but increases performance of some and decreases performance of others. In the present study the drug effect did not even approach significance. However, two user effects (tapping and serial recall) approached significance. This suggested that long-term, high caffeine use may influence task performance, but immediate caffeine use does not. High users tended to recall more words and respond faster to stimuli than low users, though not significantly ($p <.10$). Estler (1982) did suggest that these measures can be affected by caffeine, and

the trends in our data support this.

The strong main effect of tapping rate between males and females and the absence of any type of interaction simply suggests that males tap faster that femaies.

The underlying hypothesis of this research was that caffeine enhances performance when subjects were familiar with performing a task in conjunction with caffeine. Since no drug effect was found, this hypothesis is unsupported. However, our results suggest a long-term-use effect; marginally significant ($p<.10$) user effects were found in two variables. This might indicate that caffeine's effects are more pronounced with long-term high use than in the immediate state.

Extroverts reported higher consumption levels of caffeine than introverts. Differences between extroverts and introverts have been found previously. Revelle, et. al. (1980) and Bales (1984) reported that caffeine hindered introverts on certain cognitive tasks, and suggested that these differences may be explained by differences in resting levels or cortical arousal. Revelle et. al., (1980) suggests that, for any task, there is an optimum level of arousal for performance, and this level is often expressed as a curvilinear, inverted-U shaped curve (Bales, 1984).

Our extroversion/introversion data suggest two possible causal relationships: (a) high caffeine consumption increases extroversion, or (b) people become more extroverted when they consume more caffeine. The extroversion data may help to explain the variability in previous human caffeine studies (e.g. studies reported in Weiss and Laties (1962) and Estler (1982)).

Introverts and extroverts may not have been balanced in previous designs. This may suggest that to detect the effects of caffeine one must balance introverts and extroverts within the design.

A problem in interpreting the correlation data is that extroverts may tend to overstate their caffeine intake due to their nature as extroverts, while introverts may do the opposite. This is a weakness of self-reported data.

The real task is to design research to further explore the differential effects caffeine has on extroverts and introverts. Understanding differences in caffeine's effect between personality types may lead to a greater understanding of how caffeine effects us, and the nature of human personality and how it is determined.

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